Addict Death Rates during a Four-Year Posttreatment Follow-up

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Abstract: Mortality rates were examined among 3,324 Black and White daily opioid drug users for a four-year period following treatment in community-based agencies located across the United States. A total of 179 of these addicts died during this follow-up period, yielding a death rate of 15.2 per 1,000 person-years at risk. When adjusted for age, addict death rates were found to be three to 14 times higher than those in the general US population. Life table analysis was also used to examine these rates in relation to client demographic, background, and treatment variables obtained prospectively, both prior to and during treatment. Age, alcohol use, and criminal history were positively associated with higher death rates. With regard to causes of death, age proved to be the only significant predictor; older addicts (over 30) had the highest percentages of deaths due to "natural" causes, while over three-fourths of the deaths among younger addicts were drug related or involved violence. (*Am J Public Health* 1982; 72:703–709.)

The mortality rate among drug users in the United States represents a significant public health concern, but reliable estimates of these data are subject to many limitations. For instance, official reports from medical examiner offices as well as hospital emergency rooms (such as those included in the national Drug Abuse Warning Network, sponsored by the Drug Enforcement Administration and the National Institute on Drug Abuse) are incomplete in their coverage of drug-related incidents. In addition, studies based on these types of information are generally retrospective in design and the size of the base population cannot be determined to allow precise estimates of mortality rates.

Defining the appropriate base population for such studies is also difficult because of the variety of licit and illicit drugs involved, the frequency and amount of drug use required to define the population at risk, and the problems of identifying "hidden" users who do not come to the attention of legal, medical, or other treatment authorities. Furthermore, mortality rates for heterogeneous populations of drug users have limited applicability if they cannot be assessed in relation to individual characteristics (e.g., demographic variables, drug use patterns, and other background measures).

The best solution to these problems involves the use of prospectively designed research samples, but there are relatively few such studies in the drug abuse literature.[1] One of the best defined contemporary samples of drug users includes daily opioid users admitted to community-based drug abuse treatment programs. For this type of sample, death rates and causes of death have been examined for opiate addicts in different types of treatments in the nationally-oriented Drug Abuse Reporting Program, but only for the time clients remained in treatment.[2–4] Research by Concool, *et al*, addressed addict death rates both during and after treatment, but their data were limited to a single methadone maintenance program.[5]

Previous research has found higher overall death rates among older addicts,[2–4] but other measures—such as sex, marital status, employment, criminal history, and drug involvement—have also been implicated as contributing factors.[3,4,6–9] Together, these measures appear to define a population group and life-style (i.e., single males who are criminally invested) that involves greater danger, especially violent death. With regard to drug use patterns, heavy alcohol users as well as users of depressants, such as alcohol or barbiturates, in combination with other drugs appear to be more vulnerable to drug-related deaths.[3,8–12]

The present study uses a prospective design to examine mortality rates, causes of death, and predictors of death among opiate addicts following treatment in a variety of settings. It is an extension of previous work based on the Drug Abuse Reporting Program (DARP) which examined during-treatment mortality rates,[2–4] and it is part of a long-term evaluation project on drug abuse treatment effectiveness.[13–15] In particular, this study focuses on a sample of addicts who were followed up for five to six years after admission to DARP treatment.

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Materials and Method

Data Source and Fieldwork

Data for the present study were collected as part of a nationally-oriented posttreatment follow-up research project on samples of drug users admitted to community-based treatment programs between 1969 and 1973.[13-15] Replicated post-DARP outcome studies have been reported on different admission cohorts,[16-19] and detailed descriptions of the sampling design and field procedures are available elsewhere.[20,21] Altogether, a total of 6,402 former clients were selected from 34 treatment agencies located across the United States. They included clients from methadone maintenance (MM) programs, therapeutic communities (TC), outpatient drug free (DF) treatments, out-patient detoxification (DT) programs, and a comparison group labeled intake-only (IO) that completed admission (intake) procedures but did not return to receive treament in the DARP. Most of the DARP agencies studied were multimodality treatment programs, and the follow-up sample included clients from at least 18 different programs for each treatment modality or group. Specific treatment objectives and strategies developed within individual programs differed to some extent, but each focused on the abuse of drugs and related problems.[22]

The field work, including locating and interviewing of former clients, was carried out between 1975 and 1979. Overall, 5,340 persons (i.e., 83 per cent) from the target sample of 6,402 were located; 73 per cent of the total was interviewed after granting informed consent, 5 per cent was deceased, 1 per cent was out of the country (mainly due to military service), and 4 per cent exercised their right of refusal to be interviewed. The remaining 17 per cent (N = 1,062) could not be located within the time and resources allocated for this purpose. Analysis of DARP admission and during-treatment records revealed no major differences that were systematically related to whether or not former clients were located and interviewed.[23]

Subjects

For purposes of the present study, located cases were used as the population base for computation of death rates. This included persons in the target follow-up sample who were interviewed, those who were alive but unavailable for interview (either due to overseas military services or confined to long-term institutional care), and those who refused to be interviewed. Those who could not be located or otherwise accounted for were excluded. Information concerning date and cause of death was taken from death certificates and medical examiner reports.

In addition to the 1,062 persons who could not be located, another 78 persons with miscellaneous problems* were excluded from this study, leaving 5,262 persons from the total follow-up sample; they included 4,627 interviewed cases, 309 persons who were alive but not interviewed (because of refusal, or living outside the country due to military service), and 326 deceased persons.

To meet the overall research objectives of the DARP follow-up project, a stratified random sampling strategy was used to ensure adequate representation of selected client and treatment samples. This procedure was necessary because of certain constraints imposed by the characteristics of the DARP admission population.[20,21] In particular, some race-ethnic groups and some types of drug users could not be sampled sufficiently for some treatment groups (e.g., there were few Mexican-Americans in TC programs, and nonopioid drug users were not treated in MM programs). The implications of the sampling will affect analytic plans in any research using this data system.

With regard to the present study, it was decided to limit the analyses to opioid addicts, defined as persons who used heroin, illegal methadone, or other opiate drugs on a daily basis within the two months before admission to treatment in the DARP. Thus, all individuals whose preadmission baseline drug use included only nonopioids (i.e., cocaine, amphetamine and other stimulants, barbiturates and other sedatives, hallucinogens, marijuana, and other drugs) or less-than-daily opioid use were excluded; this involved the exclusion of some persons who had only a previous history of daily opioid use. By using this sample, the study focused on the major type of drug user served by most treatment programs in the DARP, and extraneous sources of variance that tend to confound interpretations of results based on a broader and more heterogeneous DARP sample were controlled to some extent.

There were 3,663 persons in the located sample of 5,262 who were defined as current daily opioid users at the time of admission to the DARP. These 3,663 opioid addicts included 1,915 Blacks, 1,409 Whites, 188 Mexican-Americans, and 151 Puerto Ricans. The Black and White samples included both males and females from all five DARP treatment groups (MM, TC, DF, DT, and IO). The Mexican-American and Puerto Rican samples, on the other hand, included only males and furthermore were represented only in the MM treatment group. Because study plans included a comparison of mortality rates by sex as well as DARP treatment groups, the small Mexican-American and Puerto Rican samples were excluded.

This reduced the final sample to a total of 3,324 Black and White opioid addicts, primarily heroin users; 58 per cent Black and 42 per cent White; 72 per cent male and 28 per cent female. With respect to age at the time of admission to DARP (i.e., about six years before the follow-up interview), 23 per cent were under 21 years old, 32 per cent were age 21 to 24, 24 per cent were ages 25 to 30, and 21 per cent were over age 30. Only 16 per cent had never been arrested. Drug use during the two months pre-DARP included non-opioid drugs, other than marijuana along with their daily opioid use by 55 per cent, and the other 45 per cent used daily opioid drugs alone or, in some cases, with marijuana. Finally, 46 per cent were treated in MM programs, 25 per cent in TC programs, 12 per cent in DF programs, 11 per cent in DT programs, and 6 per cent were in the IO group.

*Some individuals were found to have been admitted to DARP programs for reasons other than drug abuse and thus could not be considered part of the population under study.

Deaths that occurred within the first four years after DARP in this sample totaled 179, or about 5 per cent; virtually the same proportion of deaths occurred in each of the descriptive categories reported above for the base sample. The only exception involved age, with the deceased sample being older: 15 per cent were under age 21, 50 per cent were ages 21 to 30, and 35 per cent were over age 30.

Independent Variables

Mortality rates were analyzed in relation to 18 variables, representing individual background measures reported at the time of admission to the DARP as well as during-treatment information recorded on client status and progress reports obtained every two months throughout DARP treatment. These include: demographic variables (age at admission, race, sex, and marital status); background and socioeconomic status (pre-DARP employment history, usual occupation, intactness of the family during childhood, religious involvement, and criminal history); drug use background (pre-DARP nonopioid use, periods of abstinence from opioid drugs, alcohol consumption, and method of heroin intake); and drug abuse treatment history (source of DARP referral, number of pre-DARP treatment episodes, type of DARP treatment, and length of time spent in DARP treatment). Finally, the year of admission to DARP treatment was examined to assess time-related changes since the sample was taken from three separate DARP admission cohorts over a four-year period.**

Analysis

Mortality was investigated primarily using life table analysis.[31] In particular, it was used to estimate cumulative survival rates for different groups (e.g., as defined by the client background and treatment variables) and to test whether the cumulative rates were significantly different. In addition, estimates of survival rates during successive and discrete intervals of time during the post-DARP follow-up period were examined.

Death rates per 1,000 person-years were also computed so that comparison could be made with the results of previous DARP research[2-4] and with those published by the US Bureau of the Census for the general population. These death rates per 1,000 person-years are computed by dividing the number of deaths by the person-years following treatment, and then multiplying this number by 1,000.

Classifications of causes of death for persons in the deceased sample were based on death certificates and involved four categories.

- *Violence*—Deaths due to traumatic events including homicide, suicide, gunshot wounds, automobile accidents, carbon monoxide poisoning, hanging, and burns;
- *Drug-Abuse Related*—Deaths due to overdose of drugs, attributed to anaphylactic shock, or associated with chronic drug abuse, such as alcoholism, cirrhosis, hepatic coma, hepatitis, and emboli formed from talc;
- *Other Causes*—Deaths attributed to cerebral vascular accidents, cardiac conditions, kidney failure, pulmonary emboli, pleural effusion, leukemia, cancer, infection, cellulitis, meningitis, and other "natural" causes;
- *Unknown*—Cause of death could not be determined by the medical examiner or the cause was not made available to the reporting agency.

As noted by Watterson, *et al*, the relationships that may exist between the ingestion of drugs and the conditions precipitating death are very complex.[4] For example, deaths classified as violent may occur as a consequence of the addicts' membership in a drug culture; attendant risks (gunshot wounds, stabbings, and other homicidal acts) are involved in obtaining a daily supply of drugs, or occur as a result of lowered perceptual abilities causing auto accidents, burns, etc. Deaths attributed to other causes, such as pulmonary emboli, pleural effusion, subacute bacterial endocarditis, and local or systemic infections, are examples of conditions which may be sequelae to the use of street drugs of questionable composition.[11,32]

Results

Separate life table analyses were completed for each of the 18 client background and treatment variables examined, but only six of these variables were significantly related ($p < .05$) to survival curves. The significant factors were age at DARP admission ($p < .001$), pre-DARP alcohol consumption level ($p < .02$), number of pre-DARP arrests ($p < .03$), whether the person was actively involved in religion ($p < .03$), type of DARP treatment received (the overall test was not significant, but MM was found to be significantly different from DF in post hoc comparisons, $p < .05$), and year of admission to DARP treatment ($p < .01$). None of the remaining 12 variables were related to significant differences in addict mortality rates.

The cumulative percentages of persons deceased at the end of 12, 24, 36, and 48 months during the follow-up period are presented in Table 1 in relation to significant predictor variables (except for type of treatment and year of admission); 1.3 per cent, 2.8 per cent, 4.1 per cent, and 6.1 per cent was deceased at the end of each respective period. These percentages are the complements of the survival rates calculated in the life table analysis.

Mortality rates were significantly higher for older clients. Heavier alcohol users showed significantly higher mortality rates than lesser users, and the under-1 ounce category had a significantly lower percentage of deaths than either the 1–6 or the over-15 ounce categories (but not the 7–15 ounce category).

Using the total number of lifetime arrests before DARP, the 1–2 and 3–7 arrests categories were both significantly lower than the over-7 category, but the no arrest category was not significantly different from the other three categories. A small but statistically significant difference in survival

**These variables are defined in detail and analyzed in relation to posttreatment outcome measures in other studies in the DARP research.[24-30]

TABLE 1—Summary of Mortality Rates during the Post-DARP Follow-up Period, by Predictor Variables

Predictor Variables	Cumulative Per Cent Deceased, by Months Post-DARP[a]				Death Rates[b] (per 1000)	No. of Persons
	12	24	36	48		
Age at DARP Admission						
Under 21	0.5	2.2	2.5	3.8	9.5	774
21–30	1.3	2.3	3.7	5.2	13.1	1858
Over 30	2.3	4.7	7.0	11.1	28.0	692
Pre-DARP Alcohol Use (in 80-proof equivalent)						
Under 1 oz. per day	1.2	2.5	3.5	5.4	13.6	2327
1–6 oz. per day	1.9	3.9	5.3	8.2	20.3	313
7–15 oz. per day	1.1	2.2	4.7	7.0	17.3	362
Over 15 oz. per day	2.7	5.4	8.5	9.9	26.8	186
Pre-DARP Lifetime Arrests						
None	1.5	3.1	4.6	6.4	16.4	521
1–2	1.6	2.9	3.5	4.7	12.1	879
3–7	1.0	2.2	3.4	5.2	12.9	1031
Over 7	1.4	3.3	5.4	8.4	20.7	833
Active in Religion						
Yes	2.1	4.3	6.0	7.7	20.5	516
No	1.2	2.5	3.8	5.9	14.5	2733
TOTAL SAMPLE	1.3	2.8	4.1	6.1	15.2	3324

[a]Represents the complement of survival rates calculated in the life table analysis.
[b]Calculated per 1,000 person-years at risk during the total post-DARP follow-up period.

rates was found in relation to pre-DARP religious involvement.

As indicated previously, two other variables (type of DARP treatment and year of admission) were also significantly related to mortality rates, but they are not included in Table 1 due to confounding with other measures: clients admitted to the DARP during its earlier years (1969 to 1971) were older, had more years of opioid addiction, and more extensive criminal histories than later admission cohorts. When age and number of arrests in the life table analysis were controlled, the survival rates among the three admission cohorts were no longer significantly different.*** The differences in survival rates between the DARP treatment groups (which involved only the outpatient MM and DF treatment groups) were also explained by controlling for age differences. The results for each of the other four significant predictor variables in Table 1 could not be accounted for by controlling for other variables.

Estimates of death rates per 1,000 person-years are also presented in Table 1 for comparisons with other research. The relationships of these death rates with predictor variables are the same as those of survival rates over time, as discussed above.

Comparisons with the General US Population—Comparisons of these overall death rates with the general US population[33] show that they are almost twice as high (15.2 deaths per 1,000 person-years, compared to 8.78 in the general population). This ratio is similar for both males and females (16.5 for males and 13.8 for females in the present sample of opioid addicts, compared to 9.94 and 7.68, respectively, in the general population). If controlled for age, however, these differences would be substantially greater since the sample in this study was almost all in the 18 to 40 year old age range. Crude comparisons involving imperfect matching of age categories showed that addict death rates among the under 21 year olds are about 14 times those for the general population, compared to ratios of about 10 and 4 in the 21–30 and over-30 age groups, respectively.†

Differences in death rates are notably smaller between age categories for opioid addicts than for the general population. Thus, the death rate of addicts in the over-30 age category (28.0) is almost three times that for the under-21 age category (9.5), but it is nine times higher in similar age categories from the general population (0.7 versus 6.3). The implication is that opioid addiction elevates mortality rates for all age groups, but especially among younger persons.

Comparisons of Death Rates during and after Treatment—Previous research by Watterson, *et al*,[4] determined that during-treatment death rates (per 1,000) were 15 in MM, 18 in DF, and 2 in TC programs, based on the DARP population from which the present study sample was drawn.†† In the present study, post-DARP follow-up death

***The use of control variables in the life table analysis is a subgrouping analytic procedure whereby relationships between independent variables and survival rates are reexamined within separate levels of the control variables.[31]

†These ratios were calculated using general population death rates of 0.7 for 10–19 year olds, 1.3 for 20–29 year olds, and 6.3 for 30–64 year olds.

††During-treatment death rates for the DT and IO groups were not applicable due to the short duration of DT services and the lack of any treatment for IO clients.

TABLE 2—Summary of Causes of Death by Age

	Per Cent by Cause of Death				
	Violent	Drug-Related	Other	Unknown	No. of Persons
Age at DARP Admission[a]					
Under 21	19	63	0	19	27
21–30	33	50	9	8	86
Over 30	26	29	35	11	66
TOTAL SAMPLE	28	44	17	11	179

[a] $\chi^2 = 29.6$, df = 6, $p < .01$

rates were 18 in MM, 9 in DF, 14 in TC programs, 16 in DT, and 13 in IO groups.

The two rates for MM are rather similar, although the rate for the follow-up period is slightly higher (i.e., 15 versus 18). This is consistent with the expectation that clients leaving a supervised life-style associated with treatment surveillance would be open to increased risks when spending full time in the community and having greater contact with street-life conditions. Comparisons of the death rates for TC dramatically support this expectation—the during-treatment rate of 2 increased sevenfold (to 14) during the post-DARP follow-up interval. Leaving the residential setting of a TC program to return to the community was associated with a death rate comparable to that observed for the MM group.

On the other hand, the during-treatment death rate of 18 for outpatient DF clients decreased to 9 in the follow-up period. Inspection of the overall during-treatment rate, however, was found to be unstable for the separate admission cohorts involved, as it increased from 10 to 13 to 21 over consecutive cohorts.[4] It is not known whether this reflects reliable and systematic changes in DF treatment programs over time or a random and erroneous sampling fluctuation.

Causes of Death

There were 179 deaths in the sample of Black and White addicts during the first four years after DARP treatment; of these, 28 per cent were violence-related, 44 per cent drug-related, 17 per cent other ("natural") causes, and 11 per cent unknown. Thus, approximately 72 per cent of the sample died by violence or from drug-related causes. These causes of death were also analyzed in relation to the 18 classification variables described earlier by using chi-square tests of association, and the results indicated that cause of death was related only to age ($p < .01$). As shown in Table 2, addicts who were over 30 years of age when admitted to DARP were less likely (compared to younger addicts) to die of drug-related deaths, and they were more likely to die from other ("natural") causes.

The percentage of addicts who died by violent or drug-related causes (72 per cent) was very close to the 73 per cent reported by Watterson, *et al,*[4] based on deaths during treatment in the DARP. Watterson, *et al,* also found that deaths due to "natural" causes were most frequent among persons over 30 years of age, and more than twice as prevalent than in the younger age groups.

Discussion

The overall death rate for opioid addicts during a four-year posttreatment follow-up period was found in this study to be 15.2 per 1,000 person-years at risk, or about 1.5 per cent per year. This death rate falls in the 1 to 2 per cent per year range consistently reported in the literature for other posttreatment follow-up studies of addicts treated in the old Public Health Service Hospitals at Lexington and Fort Worth, [34–36] in the Veterans Administration,[37] and in outpatient methadone maintenance programs similar to those included in the present study.[5,38] It is also consistent with results of studies on heroin addicts in England.[39,40] This overall rate is twice as high as in the general US population,[33] but appears to be even higher when controlled for age.

Of the 18 demographic, background, and treatment variables analyzed in relation to mortality, only a few were found to be significant: age, alcohol drinking patterns, and criminal involvement. Religious involvement prior to treatment also showed a small although marginally significant relationship with death rates, but it was conceptually inconsistent with other results and may have been due to chance. In addition, information on religion collected in the follow-up interview showed that "membership," "attendance," and self-perceived "religiosity" were not highly interrelated, and thus the item for "active membership" on admission to treatment (yes versus no) as used in this study may greatly oversimplify this concept.

The relationship between age and mortality rate appeared to be influenced in part by cause of death. Younger addicts were more likely to have died due to violence and drug use—82–83 per cent of the deaths in the under-21 and 21–30 year olds was directly related to drug use or involved violence, compared to 55 per cent in the over-30 year olds. The proportion of deaths due to violence was highest (33 per cent) in the 21–30 age group, which is consistent with other research on this data system.[41]

Other studies based on these data also document the association between pretreatment and follow-up measures of criminality[24] and of alcohol use,[26] which strengthens the interpretation that continued investment in these behaviors are predictive of higher risks of death. This is also consistent with other research,[2,3,6–12] and the prospective nature of the data base used in this study further emphasizes these rela-

tionships. Indeed, if full follow-up information were available on these behaviors, especially for the time immediately before death for the deceased sample, even stronger relationships probably would be observed for these variables; other variables such as employment, treatment status, and drug use patterns might also have proven to be significant predictors if recorded closer in time to each person's death.

Previous studies addressing the effectiveness of treatment on follow-up outcomes using these data have identified persons treated in MM, TC, and DF programs as having significantly better outcomes than persons in DT and IO groups.[14-19] Furthermore, these outcomes were positively related to length of time spent in treatment.[28] The present findings, however, indicated that these treatment effects apparently do not encompass mortality rates.

The length of time spent in treatment likewise was unrelated to risk of death during the follow-up period. Nevertheless, it should be pointed out that behavioral changes following treatment in the DARP as well as those associated with other significant events (including other treatments) in the post-DARP follow-up interval were not taken into account in the analysis of mortality. This is important because the effects of treatment were not uniform, and over half of the total follow-up sample interviewed also reported one or more other treatments during the follow-up period.[29,30] Over time, therefore, the specific impact of treatment in the DARP should diminish in relation to other life events and become more difficult to detect. For this reason, analysis of data during a shorter posttreatment follow-up period (e.g., one year) has been used in other studies to investigate the immediate effects of treatment.[17-19] Low-prevalence data such as death rates are subject to serious limitations in evaluation strategies, however, and the use of a relatively short time period introduces additional generalization problems in the study of mortality.

The high mortality rate among opioid addicts, as found in this and other studies, could reflect much more than the fact that heroin or other opiate drugs were used daily during a given time period, i.e., at the time of admission to treatment. Therefore, a variety of demographic, background, and treatment variables was examined in order to identify factors that predict individual differences in death rates among addicts. Only a few were significant (i.e., age, alcohol use, and criminal history). Alcohol problems appear to emerge as a major individual factor that might be influenced by treatment programs for addicts. In general, the data also included mortality trends that supported the profile of the high-risk life-style projected by the literature[6-9] as involving young, single males with criminal histories. Focused analyses using a multidimensional classification implied by this life-style, however, were precluded by the sample sizes available.

Interpretations of results from this and other studies of addict mortality rates should also recognize various community or environmental factors believed to be important, including the social and physical context in which the drug abuse treatment programs and addicts exist. In this study, the treatment programs generally served low income areas, usually located in inner-city neighborhoods with high crime rates and related mortality risks. These factors can be expected to contribute to the findings that mortality rates based on the present data system were high during treatment[4]—unless the clients lived in the protected residential setting of a therapeutic community—as well as during the posttreatment follow-up period. Thus, the environment and social network must be given an uncertain amount of credit as causal factors in the high addict death rate observed, particularly in the 20 to 30 age range where violence is a major cause of death.

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Third International Environment and Safety Conference and Exhibition

The Third International Environment and Safety Conference will be held at the Wembley Conference Center, England, September 1–3, 1982.

The conference will include discussions on environmental monitoring, safety, occupational health and hygiene, along with presentations on new instrumentation and equipment.

The conference plenary will be chaired by J. G. Gaddes, Director of the British Standards Institution, and officially opened by Sir Hermann Bondi, KCB, FRS, Chairman of the Natural Environment Research Council.

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